FLUKE®

187/189

True RMS Multimeter

Calibration Manual

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Table of Contents

Title **Page**

Introduction 1
Contacting Fluke 1
Precautions and Safety Information 2
International Symbols 2
Safety Information 3
Specifications 4
  Accuracy 4
  Feature Summary 4
Basic Specifications 5
Detailed Accuracy Specifications 6
Frequency Counter Sensitivity 9
Burden Voltage (A, mA, µA) 9
Input Characteristics 9
Required Equipment 10
Basic Maintenance 11
  Opening the Meter Case 11
  Removing and Reinserting the Circuit Board Assembly 11
  Replacing the LCD 12
  Reassembling the Meter Case 13
  Testing Fuses (F1 and F2) 13
  Replacing Fuses 14
  Replacing the Batteries 14
  Cleaning 15
Performance Tests 16
  Testing the Display 16
  Backlight Test 16
  Current Terminal Sensing Test 16
  Keypad Test 17
  Verification of the IR Communication Port 17
  Testing Temperature 17
  Testing Voltage, Current, Resistance, Capacitance and Diode Functions 18
Calibration 21
  Keypad Interface 21
  General Procedure 22
  Special Requirements 23
  Calibration Inputs 23

Remote Interface 25
Temperature Calibration 25
Setup 25
Procedure 26
Re-Programming Serial Number or Model Number 26
Parts and Accessories 27

List of Tables

Table	Title	Page
1.	International Symbols	2
2.	Required Tools and Equipment	10
3.	Temperature Test Input and Display	17
4.	Performance Test Steps	18
5.	Calibration Inputs	23

List of Figures

Figure	Title	Page
1.	Removing LCD Mask to Access LCD	12
2.	Testing the Current Fuses	14
3.	Battery and Fuse Replacement	15
4.	Display Test	16
5.	Locating Recessed Calibration Button	21
6.	Calibration Display	22
7.	Replacement Parts and Accessories	28

Introduction

⚠ Warning

To avoid shock or injury, do not perform the verification tests or calibration procedures described in this manual unless you are qualified to do so.

The information provided in this document is for the use of qualified personnel only.

Caution

The 187 & 189 Multimeters contain parts that can be damaged by static discharge.

Follow the standard practices for handling static sensitive devices.

The information in this manual deals with the Fluke Models 187 & 189 True RMS Multimeters, (hereafter referred to as "the meter"). Information provided includes:

- Precautions and safety information
- Specifications
- Basic maintenance (cleaning, replacing the battery and fuses)
- Performance test procedures
- Calibration and calibration adjustment procedures
- Accessories and replaceable parts

For complete operating instructions, refer to the *Model* 187 & 189 *Users Manual* located on the *187/189 CD ROM*.

Contacting Fluke

To order accessories, receive assistance, or locate the nearest Fluke distributor or Service Center, call:

USA: 1-888-99-FLUKE (1-888-993-5853)
Canada: 1-800-36-FLUKE (1-800-363-5853)
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Precautions and Safety Information

⚠Warning

If this product is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

Read the "Safety Information" page before servicing this product.

In this manual, a **Warning** identifies conditions and actions that pose hazard(s) to the user; a **Caution** identifies conditions and actions that may damage the Meter or the test instruments.

International Symbols

International symbols used on the Meter and in this manual are explained in Table 1.

Table 1. International Symbols

Symbol	Meaning	Symbol	Meaning
~	Alternating current	⏚	Earth ground
⎓	Direct current	⎓	Fuse
≂	Alternating or direct current	CE	Conforms to European Union directives
⚠	Refer to the manual. Important information.	C SP US	Conforms to relevant Canadian Standards Association directives
TÜV PRODUCT SERVICE GS	Inspected and licensed by TÜV Product Services.	⧈	Double insulated
▬+	Battery	UL	Underwriters Laboratories, Inc.
VDE	Conforms to VDE Standards		

Safety Information

⚠Warnings and Precautions

To avoid possible electric shock or personal injury, follow these guidelines:

- **Do not use the Meter if it is damaged. Before you use the Meter, inspect the case. Look for cracks or missing plastic. Pay particular attention to the insulation surrounding the connectors.**
- **Inspect the test leads for damaged insulation or exposed metal. Check the test leads for continuity. Replace damaged test leads before you use the Meter.**
- **Do not use the Meter if it operates abnormally. Protection may be impaired. When in doubt, have the Meter serviced.**
- **Do not operate the Meter around explosive gas, vapor, or dust.**
- **Do not apply more than the rated voltage, as marked on the Meter, between terminals or between any terminal and earth ground.**
- **Before use, verify the Meter's operation by measuring a known voltage.**
- **When measuring current, turn off circuit power before connecting the Meter in the circuit. Remember to place the Meter in series with the circuit.**
- **When servicing the Meter, use only specified replacement parts.**
- **Use caution when working above 30 V ac rms, 42 V peak, or 60 V dc. Such voltages pose a shock hazard.**
- **Avoid working alone**.
- **When using the probes, keep your fingers behind the finger guards on the probes.**
- **Connect the common test lead before you connect the live test lead. When you disconnect test leads, disconnect the live test lead first.**
- **Remove test leads from the Meter before you open the battery door.**
- **Do not operate the Meter with the battery door or portions of the cover removed or loosened.**
- **To avoid false readings, which could lead to possible electric shock or personal injury, replace the batteries as soon as the low battery indicator (▭) appears.**
- **Use only type AA batteries, properly installed in the Meter case, to power the Meter.**

Caution

To avoid possible damage to the Meter or to the equipment under test, follow these guidelines:

- **Disconnect circuit power and discharge all high-voltage capacitors before testing resistance, continuity, diodes, or capacitance.**
- **Use the proper terminals, function, and range for your measurements.**
- **Before measuring current, check the Meter's fuses and turn power OFF to the circuit before connecting the Meter to the circuit.**

Specifications

Accuracy

Accuracy is specified for a period of one year after calibration, at 18 °C to 28 °C (64 °F to 82 °F), with relative humidity to 90 %. Accuracy specifications are given as:

± ([% of reading] + [number of least significant digits])

AC mV, AC V, AC µA, AC mA, and AC A specifications are ac-coupled, true rms and are valid from 5 % of range to 100 % of range. AC crest factor can be up to 3.0 at full-scale, 6.0 at half-scale, except the 3000 mV and 1000 V ranges where it is 1.5 at full scale, 3.0 at half-scale.

Feature Summary

Feature	Description
Dual Digital Displays **Analog Bar Graph**	Primary: 50,000 counts Secondary: 5,000 count Bar graph: 51 segments, updates 40 times/second
Backlight with 2 brightness levels	Bright white backlight for clear readings in poorly lighted areas
Fast Autorange	Meter automatically selects best range - instantly
AC+DC true rms, ac rms specified to 100 kHz	Choices for AC only, AC and DC dual display, or AC+DC readings
dBm, dBV	User selectable impedance references for dBm
AutoHOLD	Holds readings on display
Continuity / Open test	Beeper sounds for resistance readings below threshold, or to indicate a momentary open circuit
Fast Bar Graph	51 segments for peaking and nulling
Duty cycle / Pulse width	Measure signal on or off time in % or milliseconds
MIN MAX Mode **FAST MN MX with 24-hour time stamp**	Record maximum, minimum, and average values. 24-hour clock for MAX or MIN, elapsed time for AVG. FAST MN MX captures peaks to 250 µsec.
Closed-Case Calibration	No internal adjustments needed
Battery / Fuse Access Door	Battery or fuse replaceable without voiding calibration
Hi-Impact Overmolded Case	Protective holster features

Basic Specifications

Function	Ranges/Description
DC Voltage	0 to 1000 V
AC Voltage, true RMS	2.5 mV to 1000 V – 100 kHz bandwidth
Basic Accuracy	DC voltage: 0.025 % AC voltage: 0.4 %
DC Current	0 to 10 A (20 A for 30 seconds)
AC Current, true RMS	25 μA to 10 A (20 A for 30 seconds)
Resistance	0 to 500 MΩ
Conductance	0 to 500 nS
Capacitance	0.001 nF to 50 mF
Diode Test	3.1 V
Temperature	–200 °C to 1350 °C (–328 °F to 2462 °F)
Frequency	0.5 Hz to 1000 kHz
LOGGING Intervals (Model 189 only)	At least 288 intervals may be stored. Up to 700 unstable event values (see AutoHold) are automatically added to LOGGING memory for viewing only through optional PC software. Additional intervals will be logged up to 995 if the signal is stable.
SAVE Readings (Model 189 only)	Up to 100 readings may be saved by the user in a memory separate from LOGGING memory. These readings may be viewed using VIEW MEM.

Detailed Accuracy Specifications

Accuracy is specified for a period of one year after calibration, at 18 °C to 28 °C (64 °F to 82 °F), with relative humidity to 90 %. Accuracy specifications are given as:

± ([% of reading] + [number of least significant digits])

AC mV, AC V, AC µA, AC mA, and AC A specifications are ac coupled, true rms and are valid from 5 % of range to
100 % of range. AC crest factor can be up to 3.0 at full-scale, 6.0 at half-scale except the 3000 mV and 1000 V ranges where it is 1.5 at full scale, 3.0 at half-scale.

			Accuracy				
Function	**Range**	**Resolution**	**45 Hz-1 kHz**	**20 Hz-45 Hz**	**1 kHz-10 kHz**	**10 kHz-20 kHz**	**20 kHz-100 kHz**
AC mV [1, 2]	50.000 mV	0.001 mV	0.4 % + 40	2 % + 80	5 % + 40	5.5 % + 40	15 % + 40
	500.00 mV	0.01 mV	0.4 % + 40	2 % + 80	5 % + 40	5.5 % + 40	8 % + 40
	3000.0 mV	0.1 mV	0.4 % + 40	2 % + 80	0.4 % + 40	1.5 % + 40	8 % + 40
AC V [1, 2]	5.0000 V	0.0001 V	0.4 % + 40	2 % + 80	0.4 % + 40	1.5 % + 40	8 % + 40
	50.000 V	0.001 V	0.4 % + 40	2 % + 80	0.4 % + 40	1.5 % + 40	8 % + 40
	500.00 V	0.01 V	0.4 % + 40	2 % + 80	0.4 % + 40	Not specified	Not specified
	1000.0 V	0.1 V	0.4 % + 40	2 % + 80	0.4 % + 40	Not specified	Not specified
dBV	–52 to –6	0.01 dB	0.1 dB	0.2 dB	0.5 dB	0.5 dB	1.4 dB
	–6 to +34	0.01 dB	0.1 dB	0.2 dB	0.1 dB	0.2 dB	0.8 dB
	+34 to +60	0.01 dB	0.1 dB	0.2 dB	0.1 dB	Not specified	Not specified

1. For the 5,000 count mode, divide the number of least significant digits (counts) by 10.
2. A residual reading of 8 to 180 digits with leads shorted, will not affect stated accuracy above 5 % of range.

			Accuracy			
Function	**Range**	**Resolution**	**45 Hz-1 kHz**	**20 Hz-45 Hz**	**1 kHz-20 kHz**	**20 kHz-100 kHz**
AC µA	500.00 µA	0.01 µA	0.75 % + 20	1 % + 20	0.75 % + 20	6 % + 40
	5,000.0 µA	0.1 µA	0.75 % + 5	1% + 5	0.75 % + 10	2 % + 40
AC mA	50.000 mA	0.001 mA	0.75 % + 20	1% + 20	0.75 % + 20	9 % + 40
	400.00 mA	0.01 mA	0.75 % + 5	1% + 5	1.5 % + 10	4 % + 40
AC A	5.0000 A	0.0001 A	1.5 % + 20	1.5% + 20	6 % + 40	Not specified
	10.000 A [1]	0.001 A	1.5 % + 5	1.5% + 5	5 % + 10	Not specified

1. 10 A continuous up to 35 °C, less than 10 minutes 35 °C to 55 °C. 20 A overload for 30 seconds maximum.

			Accuracy	Accuracy Dual Display AC or AC+DC [3]		
Function	**Range**	**Resolution**	**DC**	**20 Hz- 45 Hz**	**45 Hz - 1 kHz**	**1 kHz- 20 kHz**
DC mV	50.000 mV	0.001 mV	0.1% + 20	2 % + 80	0.5 % + 40	6 % + 40
	500.00 mV	0.01 mV	0.03 % + 2			
	3000.0 mV	0.1 mV	0.025 % + 5			2 % + 40
DC V	5.0000 V	0.0001 V	0.025 % + 10 [2]			
	50.000 V	0.001 V	0.03 % + 3 [2]			
	500.00 V	0.01 V	0.1 % + 2 [2]			Not specified
	1000.0 V	0.1 V	0.1 % + 2 [2]			Not specified
DC µA	500.00 µA	0.01 µA	0.25 % + 20	1 % + 20	1.0 % + 20	2 % + 40
	5,000 µA	0.1 µA	0.25 % + 2	1 % + 10	0.75 % + 10	2 % + 40
DC mA	50.000 mA	0.001 mA	0.15 % + 10	1 % + 20	0.75 % + 20	2 % + 40
	400.00 mA	0.01 mA	0.15 % + 2	1 % + 10	1 % + 10	3 % + 40
DC A	5.0000 A	0.0001 A	0.5 %+ 10	2 % + 20	2 % + 20	6 % + 40
	10.000 A [1]	0.001 A	0.5 %+ 2	1.5 % + 10	1.5 % + 10	5 % + 10

1. 10 A continuous up to 35 °C, less than 10 minutes 35 °C to 55 °C. 20 A overload for 30 seconds maximum.
2. 20 counts in dual display DC or AC+DC.
3. See AC conversions notes for AC mV and V

Function	**Range**	**Resolution**	**Accuracy**
Resistance [1]	500.00 Ω	0.01 Ω	0.05 % + 10 [3]
	5.0000 kΩ	0.0001 kΩ	0.05 % + 2
	50.000 kΩ	0.001 kΩ	0.05 % + 2
	500.00 kΩ	0.01 kΩ	0.05 % + 2
	5.0000 MΩ	0.0001 MΩ	0.15 % + 4 [2]
	30.000 MΩ	0.001 MΩ	1 % + 4 [2]
	100.0 MΩ	0.1 MΩ	3 % + 2 [4]
	500.0 MΩ	0.1 MΩ	10 % + 2 [4]
Conductance	50.00 nS	0.01 nS	1 % + 10

1. For the 5,000 count mode, divide the number of least significant digits (counts) by 10.
2. For relative humidity greater than 70 %, resistance accuracy is 0.5 % over 1 MΩ and 2.5 % over 10 MΩ.
3. Using relative mode (**REL** Δ) to zero residual reading.
4. To ensure stated accuracy, switch to conductance mode and verify that the open circuit reading is less than 0.10 nS.

Function	Ranges	Resolution	Accuracy
Capacitance [2]	1.000 nF	0.001 nF	2% + 5
	10.00 nF	0.01 nF	1 % + 5
	100.0 nF	0.1 nF	
	1.000 µF	0.001 µF	
	10.00 µF	0.01 µF	
	100.0 µF	0.1 µF	
	1,000 µF	1 µF	
	10.0 mF	0.01 mF	
	50.00 mF	0.01 mF [3]	3 % + 10
Diode Test [1]	3.1000 V	0.0001 V	2 % + 20

1. For the 5,000 count mode, divide the number of least significant digits (counts) by 10.
2. For film capacitor or better, using Relative mode (**REL** Δ) to zero residual on 1.000 nF and 10.00 nF ranges.
3. Least significant digit not active above 10 mF.

Function	Range	Resolution	Accuracy
Frequency	500.00 Hz	0.01 Hz [1]	± (0.0050 % + 1)
	5.0000 kHz	0.0001 kHz	
	50.000 kHz	0.001 kHz	
	999.99 kHz	0.01 kHz	
Duty Cycle	10.00% to 90.00 %	0.01 %	± ((voltage range/input voltage) X 300 counts) [5,6]
Pulse Width	499.99 ms 999.9 ms	0.01 ms 0.1 ms	± (3 % X (voltage range/input voltage) + 1 count) [5,6]
Temperature	–200 to +1350 °C	0.1 °C	± (1% of reading + 1 °C) [2,3]
	–328 to +2462 °F	0.1 °F	± (1% of reading + 1.8 °F) [2,3]
MIN MAX AVG	Response: 100 ms to 80 %		Specified accuracy ± 12 counts for changes > 200 ms in duration. (± 40 counts in AC for changes > 350 ms and inputs > 25 % of range)
FAST MN MX	250 µs [4]		Specified accuracy ±100 counts up to 5,000 count (full range) reading. For higher peak readings (to 20,000 counts), specified accuracy ± 2% of reading.

1. Reading will be 0.00 for signals below 0.5 Hz.
2. Accuracy specification is relative to the user-adjustable temperature offset, and assumes ambient temperature stable to ± 1 °C.
3. For ambient temperature changes of ± 5 °C, rated accuracy applies after 1 hour.
4. For repetitive peaks; 2.5 ms for single events. Use DC function settings below 20 Hz. 50 mV range not specified.
5. Frequency greater than 5 Hz, except for VDC, 500 mVDC and 3000 mVDC functions; 0.5 Hz to 1 kHz. Signals centered around trigger levels.
6. Range/input ratios also apply to current functions. 500 counts or 5 % for 10 A ranges.

Frequency Counter Sensitivity

Input Range	Approximate VAC Sensitivity (RMS Sine Wave)[1]		VAC Bandwidth [3]	Approximate VDC Trigger Levels [1]	VDC Bandwidth [3]
	15 Hz - 100 kHz [2]	500 kHz [2]			
50 mV	5 mV	10 mV	1 MHz	-5 mV & 5 mV	1 MHz
500 mV	20 mV	20 mV	1 MHz	5 mV & 65 mV	1 MHz
3000 mV	500 mV	2000 mV	800 kHz	140 mV & 200 mV	90 kHz
5 V	0.5 V	2.0 V	950 kHz	1.4 V & 2.0 V	14 kHz
50 V	5 V	5.0 V	1 MHz	0.5 V & 6.5 V	> 400 kHz
500 V	20 V	20 V	1 MHz	5 V & 65 V	> 400 kHz
1000 V	100 V	100 V	> 400 kHz	5 V & 65 V	> 400 kHz

1. Maximum input = 10 x Range (1000 V max). Noise at low frequencies and amplitudes may affect accuracy.
2. Useable at reduced sensitivity to 0.5 Hz and 1000 kHz.
3. Typical frequency bandwidth with full scale (or maximum 2 X 10^7 V-Hz product) RMS sine wave.

Burden Voltage (A, mA, µA)

Function	Range	Burden Voltage (typical)
mA - µA	500.00 µA	102 µV / µA
	5,000 µA	102 µV / µA
	50.000 mA	1.8 mV / mA
	400.00 mA	1.8 mV / mA
A	5.0000 A	0.04 V / A
	10.000 A	0.04 V / A

Input Characteristics

Function	Input Impedance (Nominal)					
Volts, mV	10 MΩ, < 100 pF					
	Common Mode Rejection Ratio				**Normal Mode Rejection**	
DC Volts, mV	>100 dB at dc, 50 Hz or 60 Hz ±0.1%				>90 dB at 50 Hz or 60 Hz ± 0.1%	
AC Volts, mV	> 90 dB dc to 60 Hz					
	Open Circuit Test Voltage				**Full-Scale Voltage**	
					To 5 MΩ	**30 MΩ + nS**
Ohms	< 5 V				500 mV	3.1 V
Diode Test	< 5 V				3.1000 V	
	Typical Short-Circuit Current					
	500 Ω	**5 kΩ**	**50 kΩ**	**500 kΩ**	**5 MΩ**	**30 MΩ**
Ohms	1 mA	100 µA	10 µA	1 µA	0.1 µA	0.1 µA
Diode Test	1 mA typical					

Required Equipment

Required equipment is listed in Table 2. If the recommended models are not available, equipment with equivalent specifications may be used.

Repairs or servicing should be performed only by qualified personnel.

Table 2. Required Equipment

Equipment	Required Characteristics	Recommended Model
Calibrator	AC Voltage Range: 0-1000 Vac Accuracy: ± 0.1 % Frequency Range: 20 Hz – 100 kHz Accuracy: ±3 % DC Voltage Range: 0-1000 Vdc Accuracy: ± 0.006 % Current Range: 0-10A Accuracy: AC mA - ±0.18 % AC A - ± 0.38 % Frequency range: 1 kHz – 20 kHz DC mA - ± 0.06 % DC A - ± 0.125 % Frequency Source: 500 Hz-20 kHz Accuracy: ± 0.00125 % Amplitude: 1 Volt Accuracy: ± 5 % Ohms Range: 0 Ω - 50 MΩ Accuracy: ± 0.0125 % Capacitance Range: 110.0 nF & 11.00 µF Accuracy: +0.25% Temperature Range: -10 to 350 °C Accuracy: 0.3%	Fluke 5520A
Thermocouple Adapter Accessory	K-type	Fluke 80AK
K-type Thermocouple	K-type, mini-plug on both ends	N/A
Serial Cable, Infrared/W IR Cable Adapter		Fluke P/N 1590638
87/89-IV, 187/189 Service Software		Fluke P/N 676152

Basic Maintenance

⚠Warning

To avoid electrical shock or personal injury, remove the test leads and any input signals before opening the case or replacing the battery or fuses. To prevent damage or injury, install ONLY batteries or fuses specified for this product.

Opening the Meter Case

Caution

To avoid unintended circuit shorting, always place the uncovered Meter assembly on a protective surface. When the case of the Meter is open, circuit connections are exposed.

To open the Meter case, do the following:

1. Disconnect test leads from any live source, turn the rotary switch to **OFF**, and remove the test leads from the front terminals.
2. Remove the battery door by using a flat-blade screwdriver to turn the battery door fasteners 1/4-turn counterclockwise.
3. The case bottom is secured to the case top by four screws, one at each corner. Remove the screws with a Phillips-head screwdriver.
4. Pull the two halves of the case apart.

Removing and Reinserting the Circuit Board Assembly

The circuit board assembly must be removed to access and replace the LCD.

Caution

The circuit board is extremely susceptible to contamination. Handle it by the input receptacle, fuse clips or edges of the board only. You can use clean surgical gloves to help avoid contamination.

1. Open the Meter case and remove the case bottom to access the circuit board.
2. Remove the two Phillips-head screws securing the circuit board to the case top and lift it out carefully to avoid contamination.
3. To reinsert the circuit board, simply place it into the case top with the LCD display showing through the window.
4. Carefully replace the two Phillips-head screws that connect the circuit board to the case top.

Caution

Do not over-torque the two Phillips-head screws when you reconnect the circuit board to the case top. Doing so may create shielding problems and cause the Meter to give incorrect readings.

Replacing the LCD

If you need to replace the LCD, you will find it easier to leave the LCD assembly attached to the circuit board and access the LCD by removing the LCD mask from the front of the LCD assembly.

1. Remove the circuit board as described under “Removing and Reinserting the Circuit Board Assembly.”
2. Carefully insert the tip of a thin screwdriver under the LCD mask at the top of the display as shown in Figure 1.

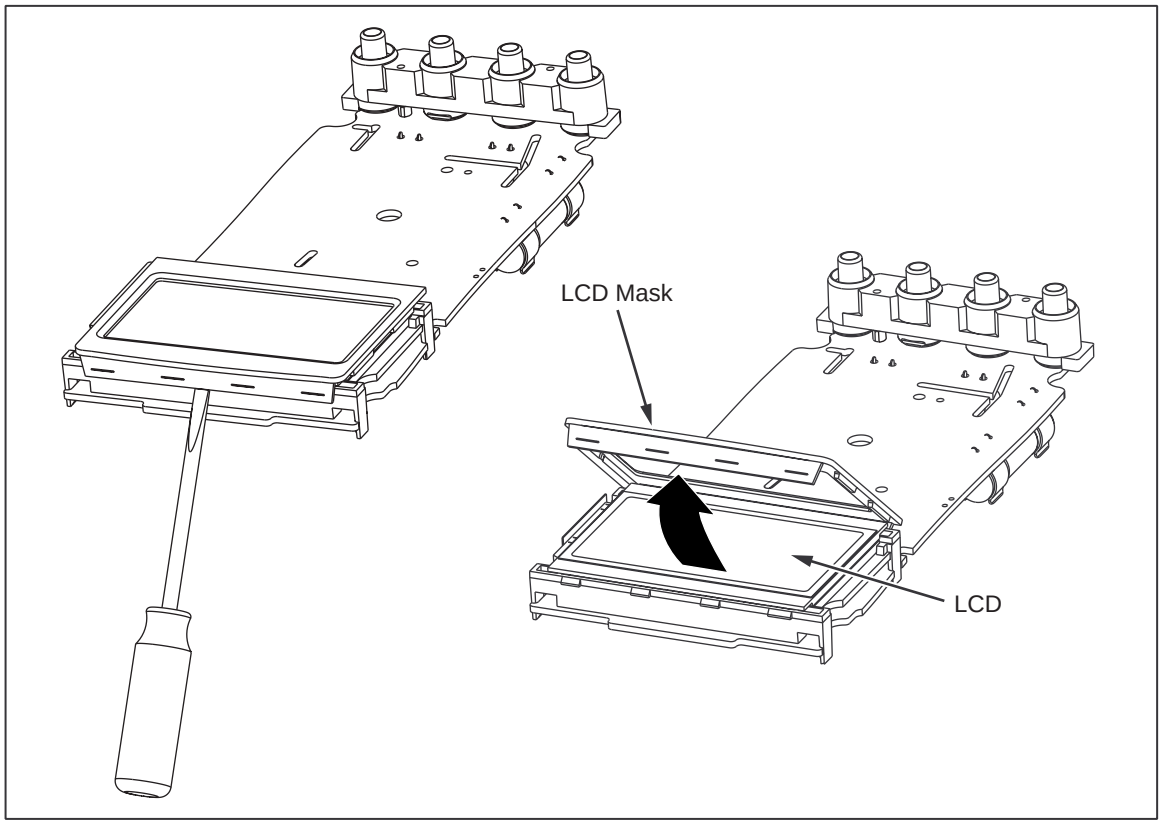

Figure 1. Removing LCD Mask to Access LCD

3. Lift up the LCD mask gently with the screwdriver blade to loosen the mask from the assembly. Be careful to press upward, not inward toward the LCD. By hand, tilt the LCD mask upward to release.
4. Replace the LCD. The LCD must be centered on the platform between the brackets before you replace the LCD mask. If the LCD is improperly aligned, the display may show missing segments or meaningless readings.
5. Reattach the LCD mask by pressing it over the LCD until it snaps into place.

Reassembling the Meter Case

To reassemble the Meter case, do the following:

1. Verify that the rotary switch is in the **OFF** position.
2. Reinsert the circuit board by placing it into the case top with the LCD showing through the window. Carefully replace the two Phillips-head screws that connect the circuit board to the case top.

Caution

Do not over-torque the two Phillips-head screws when you reconnect the circuit board to the case top. Doing so may create shielding problems and cause the Meter to give incorrect readings.

3. Hold the Meter face down and place the case bottom on the case top. Make sure the backlight cable located on the back of the LCD assembly is not caught between the case halves.
4. Reinstall the four screws and the battery door.
5. Secure the battery door by turning the fasteners 1/4-turn clockwise.
6. Go to the "Performance Test**"** section in this document, and perform the procedures described.

Testing Fuses (F1 and F2)

Before measuring current, test the appropriate fuse as shown in Figure 2. If the tests give readings other than those shown, have the Meter serviced.

⚠Warning

To avoid electrical shock or personal injury, remove the test leads and any input signals before replacing the battery or fuses. To prevent damage or injury, install ONLY specified replacement fuses with the amperage, voltage, and speed ratings shown in the specifications.

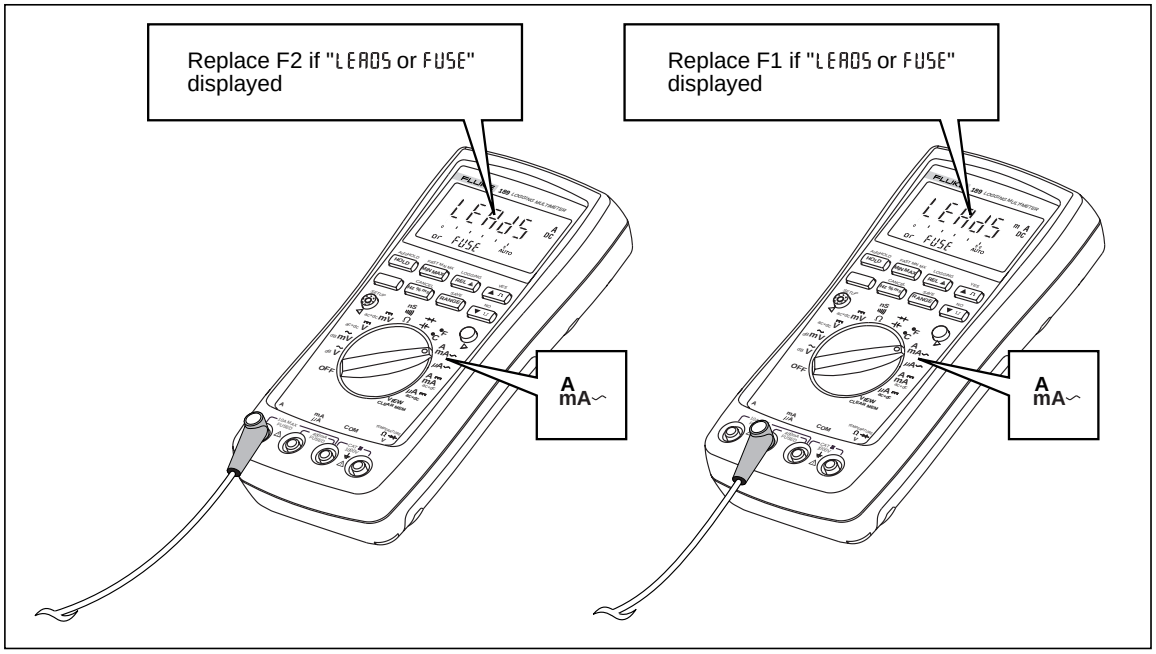

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Figure 2. Testing the Current Fuses

Replacing Fuses

⚠Warning

To avoid electrical shock, remove the test leads and any input signals before replacing the battery or fuses. To prevent damage or injury, INSTALL ONLY specified fuses and batteries.

To replace the fuses, refer to Figure 3 and do the following:

1. Turn the rotary switch to **OFF** and remove the test leads from the terminals
2. Remove the battery access door by using a standard-blade screwdriver to turn the battery door fasteners one-quarter turn counterclockwise.
3. Remove either fuse by gently prying one end loose, then lifting the fuse out of the fuse contacts.
4. Install ONLY specified fuses.
5. Reinstall the battery door. Secure the door by turning the fasteners one-quarter turn clockwise.

Replacing the Batteries

The Meter is powered by four AA batteries (NEDA 15A or IEC LR6).

Caution

Be sure to observe proper polarity when replacing batteries. Incorrect battery polarity may seriously damage the Meter.

To replace the batteries, refer to Figure 3 and do the following:

1. Turn the rotary switch to **OFF** and remove the test leads from the terminals.
2. Remove the battery door by using a standard-blade screwdriver to the turn the battery door fasteners one-quarter turn counterclockwise.
3. Replace the batteries, observing proper polarity. Replace the battery door and secure it by turning the fasteners one-quarter turn clockwise.

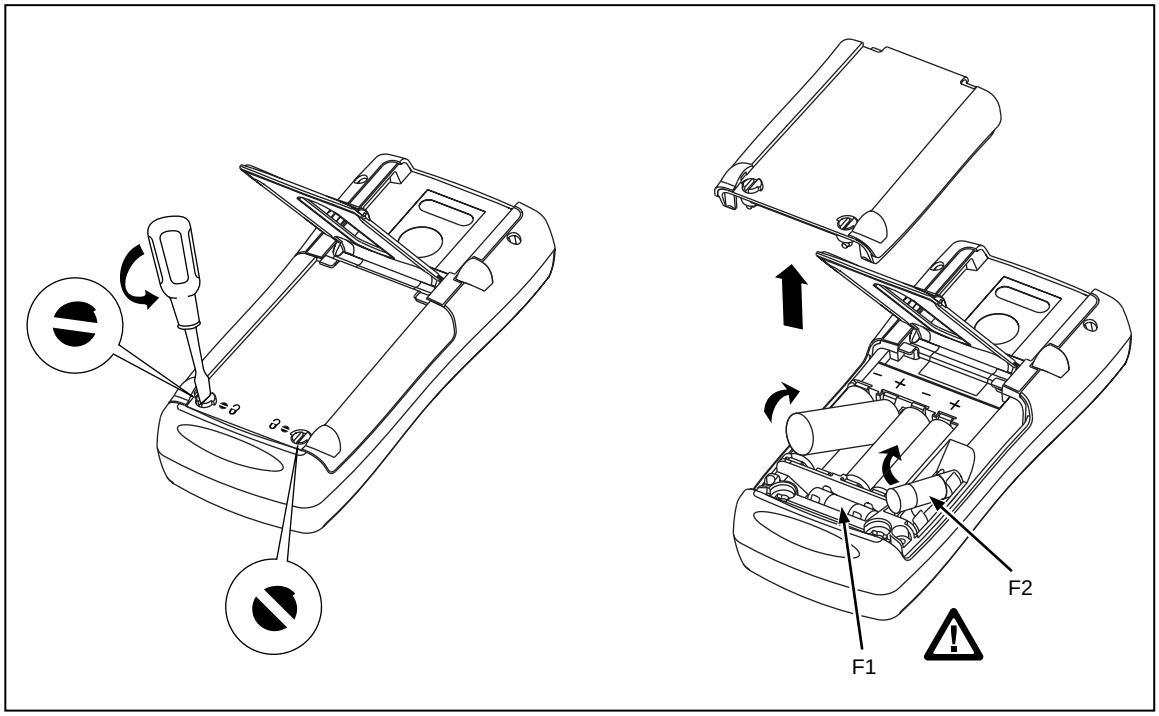

Figure 3. Battery and Fuse Replacement

Cleaning

⚠Warning

To avoid electrical shock or damage to the Meter, never allow water inside the case. To avoid damaging the housing, never apply solvents to the Meter.

Periodically wipe the case with a damp cloth and mild detergent. Do not use abrasives or solvents.

Dirt or moisture in the input terminals can affect readings and can falsely activate the Input Alert™ feature. Clean the terminals as follows:

1. Turn the Meter off and remove all test leads.
2. Shake out any dirt that may be in terminals.
3. Soak a new swab with alcohol. Clean each terminal with the swab.

Performance Tests

The following performance tests will ensure that the Meter is in proper operating condition and will check the accuracy of each meter function against its specifications. To perform the tests you will need a Fluke 5520A Calibrator or equipment meeting the minimum specification given in Table 1.

If the Meter fails any of these tests, it needs calibration adjustment or repair.

Testing the Display

Push down the HOLD button and simultaneously turn the Meter on. Compare the display with the example in Figure 4. Check all segments for clarity and contrast.

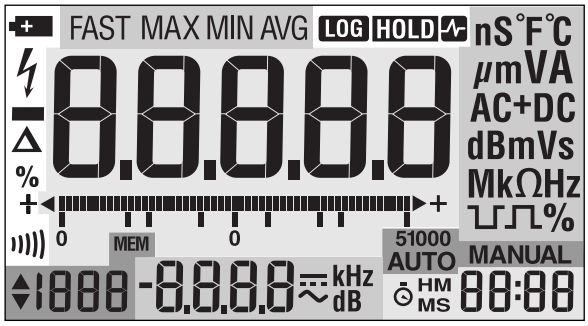

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Figure 4. Display Test

Backlight Test

To test the backlight, press the ☼ button twice. Note that the backlight comes on at two different intensity levels.

Current Terminal Sensing Test

This test determines whether or not the Input Alert™ beeper is functioning properly.

Note

Before conducting this test, make sure the beeper is not disabled in setup.

1. Turn the rotary switch to the AC V function. Press the backlight button twice to turn the backlight to the highest intensity.
2. Turn the rotary switch to all functions, except current functions. Note that the beeper does not come on.
3. Turn the rotary switch to the DC mA position. Insert a test lead into the mA terminal. Note that the beeper does not emit a continuous chirp.

Note

As the test lead is inserted, the Meter may produce a single chirp. This is acceptable.

Keypad Test

To test the keypad, turn the Meter to AC V and push each button separately. Each button push should cause the Meter to beep.

Reset the Meter by turning it **Off**, and then back **On**.

Verification of the IR Communication Port

Note

If you are using MET/CAL to do performance testing, it is not necessary to perform this verification test.

1. Connect the Infrared Serial Cable to the com port of a PC.
2. Connect the Infrared Serial Cable to the IR Cable Adapter and insert into the 187/189 accessory mount so that it is flush with the IR adapter window. Turn the Meter rotary switch to DC V.
3. Install Fluke 87/89-IV, 187/189 Service Software, P/N 676152.
4. Apply 1 V dc to the **VΩ⇥⊢** terminal.
5. The display reading should appear in text box of PC.

Note

If the PC indicates that the Meter is not connected, ensure that the com port is correct and that the IR Serial Cable and adapter is aligned with the IR window.

Testing Temperature

Connect K-type thermocouple and Fluke 80Ak to the temperature input on the Meter. Connect the other end to the 5520A TC output. Allow connections to stabilize for 30 seconds before proceeding.

1. Turn the rotary switch to the temperature function.
2. Set the 5520A for K-type thermocouple and an output of 23 °C.
3. Enter the Meter Setup mode (press yellow button, then backlight button).
4. Adjust the temperature offset until the temperature on the Meter primary display matches the 5520A output temperature (23 °C). Use the blue shift button and backlight button to advance digit. Use the up and down arrow keys to edit digit.
5. Enter an offset value by pressing the yellow button, then the backlight button.
6. Exit Setup mode by pressing the yellow button, then the **CANCEL** button.
7. Perform the steps in Table 3.

Table 3. Temperature Test Input and Display

Input	Display	
	Lower Limit	Upper Limit
-10.0 °C	-11.1 °C	-8.9 °C
0.0 °C	-1.0 °C	1.0 °C
350.0 °C	345.0 °C	355.0 °C

Testing Voltage, Current, Resistance, Capacitance and Diode Functions

To verify the accuracy of Meter functions, do the following.

1. Connect the Calibrator to the **VΩ⇥⊢** and **COM** inputs on the Meter.
2. Turn the rotary switch to the function listed in each step.
3. Apply the input from the steps listed in Table 4.
4. Compare the reading on the Meter display with the display reading in Table 4.
5. If the display reading falls outside of the range shown in Table 4, the Meter does not meet specification.
6. Repeat steps 2 through 4 for the remaining inputs shown in Table 4.

Table 4. Performance Test Steps

Step	Function	Range[1]	Input Level	Frequency or Model	Display[2]	
					Lower Limit	Upper Limit
1	AC V	5.0000 V	0.25 V	100 kHz	0.2260	0.2740
2	AC V	5.0000 V	5 V	20 kHz	4.9210	5.0790
3	AC V	5.0000 V	5 V	100 kHz	4.5960	5.4040
4	AC V	50.000 V	50 V	700 Hz	49.760	50.240
5	AC V	50.000 V	50 V	20 kHz	49.210	50.790
6	AC V	50.000 V	50 V	100 kHz	45.960	54.040
7	AC V	500.00 V	500 V	65 Hz	497.60	502.40
8	AC V	1000.0 V	500 V	65 Hz	494.0	506.0
9	AC mV	50.000	2.5 mV	100 kHz	2.085	2.915
10	AC mV	50.000	50 mV	20 kHz	47.210	52.790
11	AC mV	50.000	50 mV	100 kHz	42.460	57.540
12	AC mV	500.00 mV	500 mV	10 kHz	474.60	525.40
13	AC mV	3000.0 mV	3 V	20 kHz	2951.0	3049.0
14	AC mV	3000.0 mV	3 V	100 kHz	2756.0	3244.0
15	Frequency	50.000 kHz	1 V	20 kHz	19.998	20.002
16	Duty Cycle	3.0000 V	2.2 Vp-p, @30% Sq. wave	500 Hz	21.82	38.18
17	DC V	5.0000 V	short		-0.0010	0.0010
18	DC V	5.0000 V	5 V		4.9977	5.0023
19	DC V	5.0000 V	-5 V		-4.9977	-5.0023
20	DC V	50.000 V	-50 V		-49.982	-50.018
21	DC V	500.00 V	-500 V		-499.48	-500.52
22	DC V	1000.0 V	-500 V		-499.3	-500.7

1. Do not rely on autoranging for all tests. Some test steps will require manual ranging.
2. Must allow for source and meter settling before recording reading.
3. Wait at least 60 seconds for source and meter to settle before recording reading.
4. Using Relative Mode (REL) to zero residual reading (apply 0 Ω and allow UUT to settle for 45 seconds before pushing REL).

Table 4. Performance Test Steps (cont.)

Step	Function	Range[1]	Input Level	Frequency	Display[2]	
					Lower Limit	Upper Limit
23	AC&DC	50.000 V	50 V	20 kHz	48.960	51.040
24	DC mV	50.000	0 mV[3]		-0.020	+0.020
25	DC mV	50.000	50 mV		49.930	50.070
26	DC mV	50.000	-50 mV		-49.930	-50.070
27	DC mV	500.00 mV	0 V		-0.02	0.02
28	DC mV	500.00 mV	500 mV		499.83	500.17
29	DC mV	3000.0 mV	+2 V		1999.0	2001.0
30	DC mV	3000.0 mV	-3 V		-2998.7	-3001.3
31	AC+DC	3000.0 mV	1 V	20 kHz	976.0	1024.0
Connect 5520A for 2 Wire Comp						
32	Ohms	500.00 Ω	0 Ω[4]		-0.10	0.10
33	Ohms	500.00 Ω	500 Ω		499.65	500.35
34	Ohms	5.0000 kΩ	5 kΩ		4.9973	5.0027
35	Ohms	50.000 kΩ	50 kΩ		49.973	50.027
36	Ohms	500.00 kΩ	500 kΩ		499.73	500.27
37	Ohms	5.0000 MΩ	5 MΩ		4.9921	5.0079
38	Ohms	30.000 MΩ	30 MΩ		29.696	30.304
39	Ohms	500.0	100 MΩ		89.8	110.2
Remove 2 Wire Comp						
40	nS	50.00 nS	open		-0.10	+0.10
41	nS	50.00 nS	100 MΩ		9.80	10.20
Remove Test Leads from UUT						
42	Capacitance	1.100 nF	open		<0.070	
43	Capacitance	110.0 nF	0.1 uF		98.5	101.5
44	Capacitance	11.00 uF	5 uF		4.90	5.10
45	Diode Test	3.1000 V	1 kΩ		0.9000	1.1000
46	AC mA	50.000 mA	2.5 mA	1 kHz	2.461	2.539
47	AC mA	500.00 mA	329 mA	10 kHz	323.96	334.04
48	AC uA	500.00 uA	500 uA	1 kHz	496.05	503.95

1. Do not rely on autoranging for all tests. Some test steps will require manual ranging.
2. Must allow for source and meter settling before recording reading.
3. Wait at least 60 seconds for source and meter to settle before recording reading.
4. Using Relative Mode (REL) to zero residual reading (apply 0 Ω and allow UUT to settle for 45 seconds before pushing REL).

Table 4. Performance Test Steps (cont.)

Step	Function	Range[1]	Input Level	Frequency or Model	Display[2]	
					Lower Limit	Upper Limit
49	AC uA	5000.0 uA	1.5 mA	1 kHz	1488.2	1511.8
50	DC mA	50.000 mA	0 A		-0.010	0.010
51	DC mA	50.000 mA	50 mA		49.915	50.085
52	DC mA	50.000 mA	-50 mA		-49.915	-50.085
53	DC mA	500.00 mA	-329.00 mA		-328.49	-329.51
54	DC uA	500.00 uA	500 uA		498.55	501.45
55	DC uA	-500.00 uA	-500 uA		-498.55	-501.45
56	DC uA	5000 uA	-5 mA		-4987.3	-5012.7
57	DC uA	500.00 uA	0 A		-0.2	0.2
58	AC A	5.0000 A	250 mA	1 kHz	0.2442	0.2558
59	AC A	5.0000 A	250 mA	20 kHz	0.2310	0.2690
60	DC A	5.0000 A	0 A		-0.0010	0.0010
61	DC A	5.0000 A	5 A		4.9740	5.0260
62	DC A	-5.0000 A	-5 A		-4.9740	-5.0260
63	DC A	10.000 A	-6 A		-5.968	-6.032
64	AC A	10.000 A	6 A	1 kHz	5.905	6.095

1. Do not rely on autoranging for all tests. Some test steps will require manual ranging.
2. Must allow for source and meter settling before recording reading.
3. Wait at least 60 seconds for source and meter to settle before recording reading.
4. Using Relative Mode (REL) to zero residual reading (apply 0 Ω and allow UUT to settle for 45 seconds before pushing REL).

Calibration

Calibrate the Meter once a year to ensure that it performs to specifications.

Before you begin the calibration procedure, locate the recessed calibration button on the back of the Meter, underneath the accessory mount. It is inside a small opening covered by a seal. Carefully puncture the seal with a calibration tool to access the calibration button. See Figure 5.

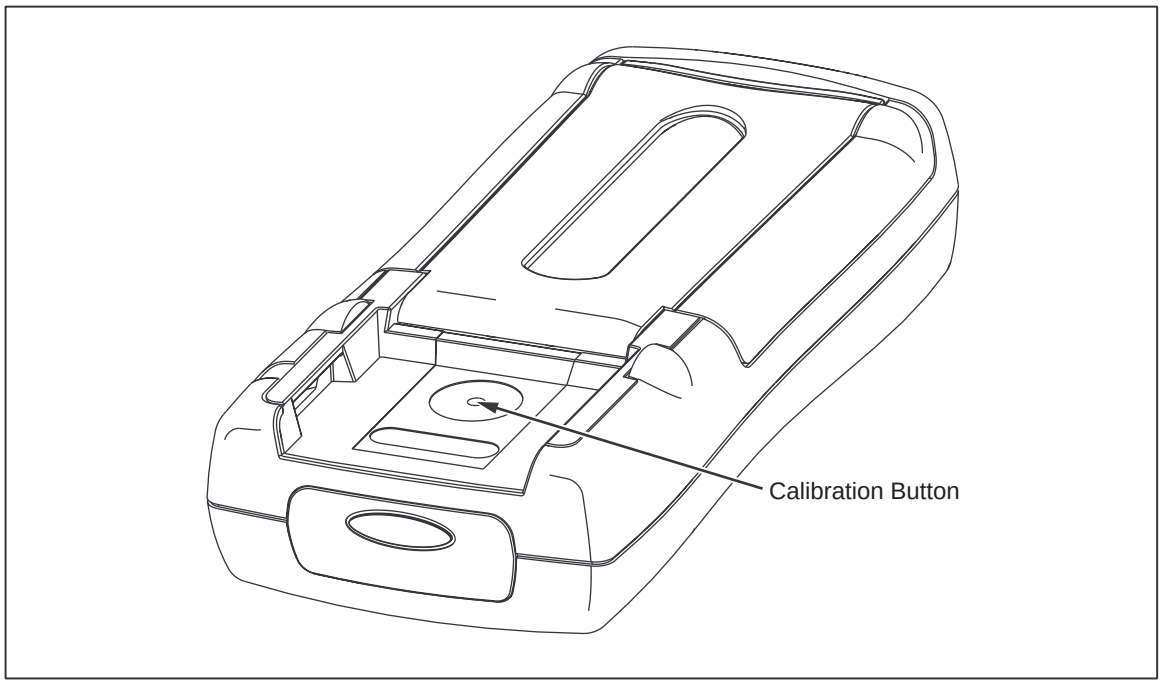

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Figure 5. Locating Recessed Calibration Button

Keypad Interface

To start the calibration procedure, turn the rotary switch to the DC mV position, then press and hold the recessed calibration button on the back of the Meter for one second. This places the Meter in calibration mode as shown on the display in Figure 6. The unit will remain in the calibration mode until the rotary switch is moved to the **OFF** position.

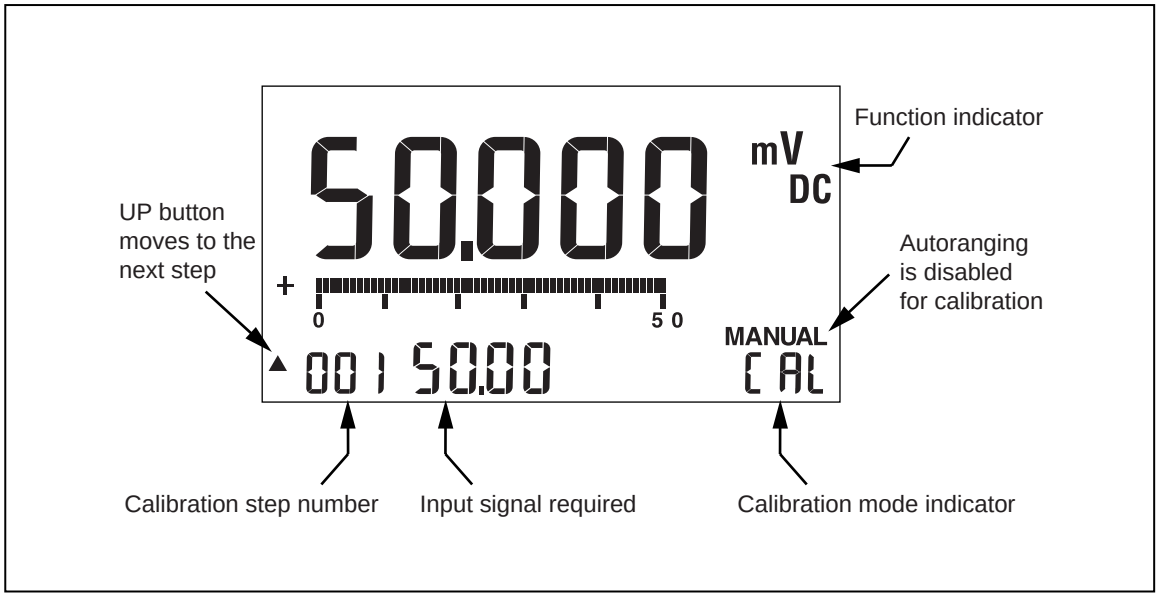

Figure 6. Calibration Display

General Procedure

A sequence of signal inputs is required for each function that must be calibrated. The secondary display shows the required input next to the step number for that function. The primary display shows the value being measured. The measurement is likely to be slightly different from the applied signal, because it may be showing an uncalibrated measurement. The general calibration procedure is as follows:

1. Move the rotary switch to the function that you are calibrating.
2. Apply the input signal indicated by the secondary display.
3. Wait for the measurement on the primary display to settle out to its final value.
4. Press the **UP** button to proceed to the next step. The Meter records a new constant.
5. Repeat steps 2 through 4 until the secondary display shows **End**. This indicates that the calibration procedure for this function is complete. New constants will not be recorded until secondary display shows **End**.
6. If there are more functions to be calibrated, move the rotary switch to the appropriate function, and continue from step one. Otherwise, turn the rotary switch to the **OFF** position to exit calibration.

Note

DC mV calibration affects the calibration of ALL functions and AC mV will affect all AC functions.

If the accuracy of the calibration source is more than approximately 15 % from the nominal value required for the cal point, then the factory default cal constants will automatically be used instead of source value. In this case, the Meter may not pass the verification test and may require re-calibration.

Special Requirements

DC mV calibration will affect the calibration of all other functions. Therefore, the DC mV function must be calibrated before calibrating any other function. Similarly, AC mV must be calibrated before any AC function, but after DC mV. The remaining functions may be calibrated in any order.

Temperature calibration need only be performed if one of the following components are replaced during the course of repair: U4 A/D chip, U10 EEPROM, or U100 Reference Junction Sensor. Temperature is calibrated by making an external temperature measurement and entering the result into the instrument for calculation of the calibration constant. The calibration constant is then stored in calibration memory. This is done using the serial interface. See "Temperature Calibration" section.

When you replace the U10 EEPROM, you must also re-enter the serial number and model number for the Meter. See "Reprogramming Meter Serial Number and Model Number" section.

Calibration Inputs

Table 5 lists the input values required for each calibration step.

Note

The column indicating time to settle does not include calibrator settling time.

Table 5. Calibration Inputs

Step	Value	Frequency	Time to Settle (In Seconds)
DC mV			
1	0 mV	DC	16
2	50 mV	DC	16
3	300 mV	DC	7
4	500 mV	DC	7
5	3000 mV	DC	1
Temperature			
1	0		1
AC mV			
1	700 mV	700 Hz	7
2	400 mV	700 Hz	7
3	100 mV	700 Hz	7
4	50 mV	700 Hz	7
5	3000 mV	700 Hz	7

1. Use 5520A 2-Wire Comp.
2. Zero ohms must use the same calibrator and test leads as all other ohm cal points. **Do not** bypass the calibrator with a shorting bar for the zero ohms step.
3. Because of capacitive coupling, readings will be affected by movement of the leads or operator. Put fingers on UP button and wait for display reading to settle before pushing.

Table 5. Calibration Inputs (cont.)

Step	Value	Frequency	Time to Settle (In Seconds)
AC V			
1	5 V	700 Hz	7
2	50 V	700 Hz	7
3	500 V	700 Hz	7
4	500 V	700 Hz	7
DC V			
1	5V	DC	7
2	50 V	DC	7
3	500 V	DC	7
4	500 V	DC	7
Ohms[1]			
1[2]	0 Ohms		16
2	500 Ohms		16
3	5k Ohms		7
Ohms			
4	50k Ohms		7
5	500k Ohms		7
6	5M Ohms		7[3]
7	30M ohms		1[3]
AC uA			
1	500 uA	700 Hz	7
2	5000 uA	700 Hz	7
DC uA			
1	500 uA	DC	16
2	5000 uA	DC	7
AC mA			
1	50 mA	700 Hz	7
2	400 mA	700 Hz	7
DC mA			
1	50 mA	DC	16
2	400 mA	DC	7

1. Use 5520A 2-Wire Comp.
2. Zero volts and ohms must use the same calibrator and test leads as all other volt and ohm cal points.
   Do not bypass the calibrator with a shorting bar for the zero volts or ohms step.
3. Because of capacitive coupling, readings will be affected by movement of the leads or operator. Put fingers on UP button and wait for display reading to settle before pushing.

Table 5. Calibration Inputs (cont.)

Step	Value	Frequency	Time to Settle (In Seconds)
AC A			
1	5 A	700 Hz	7
2	5 A	700 Hz	7
DC A			
1	5 A	DC	16
2	5 A	DC	7

1. Use 5520A 2-Wire Comp.
2. Zero volts and ohms must use the same calibrator and test leads as all other volt and ohm cal points.
   Do not bypass the calibrator with a shorting bar for the zero volt or ohm step.
3. Because of capacitive coupling, readings will be affected by movement of the leads or operator. Put fingers on UP button and wait for display reading to settle before pushing.

Remote Interface

You can perform semi-automated calibration with the remote interface using MET/CAL software.

Temperature Calibration

Required equipment:

- Fluke 87/89-IV, 187/189 Service Software, Fluke P/N 676152
- Infrared Serial Cable Kit, Fluke P/N 1590638
- IBM compatible PC
- Fluke 80T-150U with accuracy certified to ±0.2 °C
- Fluke 8060A Digital Multimeter

Note

The following procedure is only required if the Meter has been repaired by replacing one of the following components: A/D, U4, Reference Junction Sensor, U100 or EEPROM, U10.

Setup

Prior to beginning the procedure, turn the rotary switch **OFF**. Let the Meter stabilize in a constant ambient temperature for 30 minutes. This allows the internal reference junction sensor and input terminals to stabilize to the same temperature.

Connect the IR Serial Cable to the serial com port of the PC. Install the 87/89-IV, 187/189 Service Software.

Procedure

While the rotary switch is in the **OFF** position, insert the certified 80T-150 probe into the Meter's **COM** terminal (same temperature as reference junction). Make sure the probe tip makes firm contact with the bottom of the terminal. Measure and record the **COM** terminal temperature in units of 1/100 °C. Do not convert this number to Fahrenheit, even if the Meter is using the Fahrenheit scale for its display output.

Turn the rotary switch to the temperature position. It does not matter whether the Meter is in calibration mode. On the Service Software menu screen, click °**C Ref. Junction**. Enter the measured temperature value in the text box and click **OK**. This sends the recorded reference junction temperature to the Meter through the IR Serial Cable.

Although the temperature calibration is not yet complete, it is safe at this point to turn the Meter off if the need arises. Doing so will not invalidate the previous steps.

To complete the temperature calibration, the DC mV function must be calibrated.

After DC mV calibration is complete:

1. Turn the rotary switch to the temperature position. Put the Meter in calibration mode by pressing the recessed button on the back of the Meter.

   The secondary display, which normally shows the required input, displays zero. In this case, no input is required.

2. Press the **UP** button.

   This sends the calculated temperature constants to EEPROM, and completes the temperature calibration.

3. Continue calibrating the other functions, or turn the rotary switch to the **OFF** position to exit calibration.

Re-Programming Serial Number or Model Number

When the U10 EEPROM is replaced, you must also reenter the serial number and model number for the Meter. Do this as follows:

1. Connect the IR Serial Cable to the serial com port of the PC. Install 87/89-IV, 187/189 Service Software (Fluke P/N 676152).
2. Turn the Meter rotary switch to any function.
3. On the Service Software menu screen, click **EEPROM**. Enter the serial number from the back of the Meter in the text box and click **OK**. To enter the model number, click **Yes** or **No** in the model menu box.

Parts and Accessories

Replacement parts and accessories are listed in Table 6 and identified in Figure 7 by the reference designator.

Table 6. Replacement Parts and Accessories

Description	Reference Designators	Part Number	Qty
Access Door, Battery / Fuse	MP14	1589387	1
Tilt-Stand	MP8	659026	1
Accessory Mount	MP9	658424	1
⚠Fuse, 0.44 A (44/100 A, 440 mA), 1000 V, FAST	F1	943121	1
⚠Fuse, 11 A,1000 V FAST	F2	803293	1
Battery, 1.5 V, 0-15 mA, AA Alkaline	H8, H9, H10, H11	376756	4
Fasteners, Battery / Fuse Access Door	H12, H13	948609	2
Screws, Phillip-Head	H4, H5, H6, H7	832246	4
AC70A Alligator Clip (Black)	MP38	738047	1
AC70A Alligator Clip (Red)	MP39	738120	1
TL71 Right-Angle Test Lead Set	MP34	802980	1
LCD 4.5 Digit Multiplexed	DS1	688181	1
Connector, Elastomeric, LCD to PWB[1]	MP30, MP31	690883	2
Getting Started Manual	(TM1-TM5)	See Note Below[2]	5
CD-ROM (Contains Users Manual)	(TM6)	1576992	1

⚠To ensure safety, use exact replacement only.

1. Order replacement connectors separately when ordering a replacement LCD.
2. Getting Started Manual PNs: English=1547486; French, German, Italian, Dutch=1555282; Danish, Finnish, Norwegian, Swedish=1555307; French, Spanish, Portuguese=1555294; Simplified Chinese, Traditional Chinese, Korean, Japanese,Thai=1555318

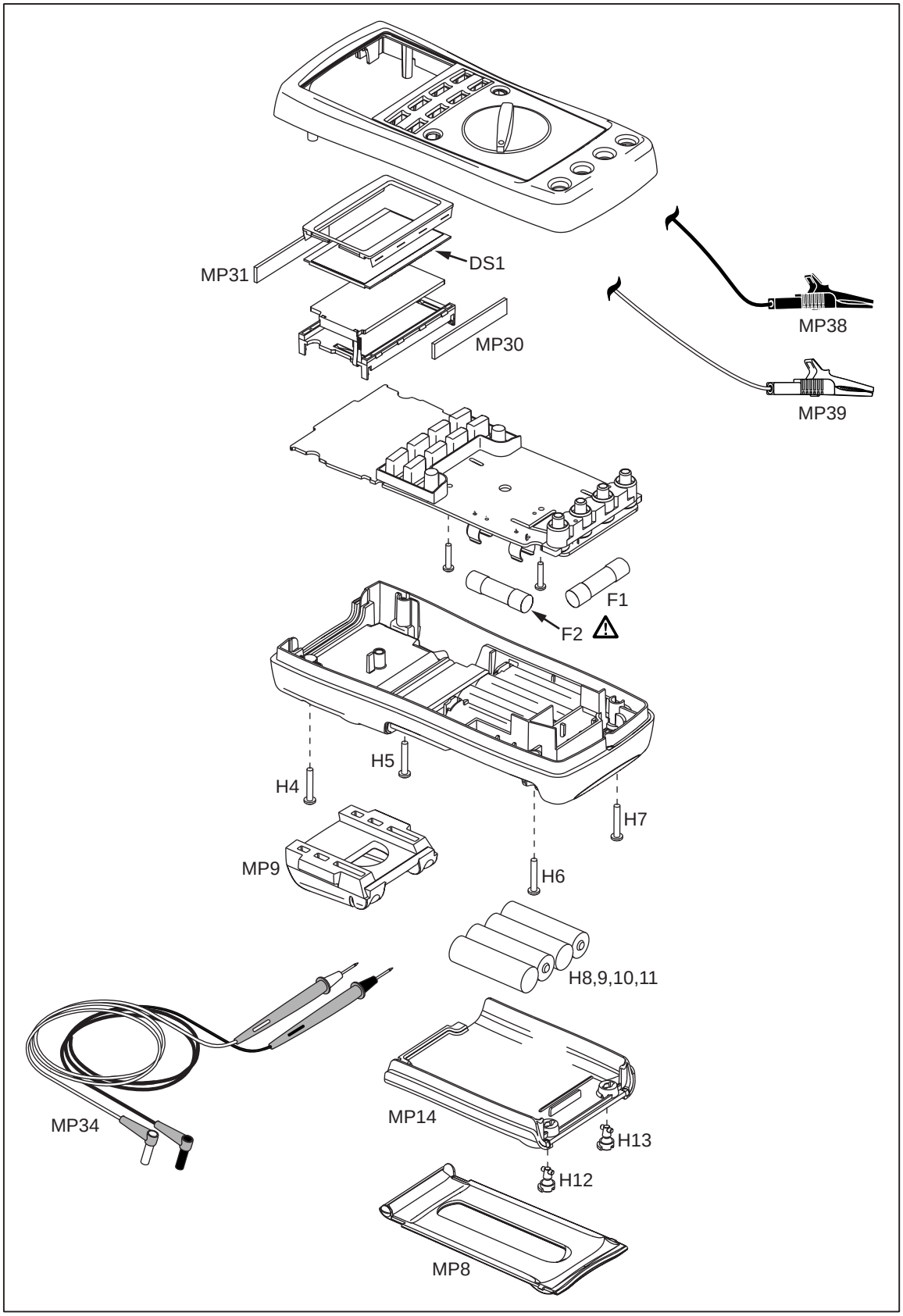

Figure 7. Replacement Parts and Accessories

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FLUKE®

Fluke 187/189 True-rms Digital Multimeter
Extended Specifications

Nominal Specifications

Function	Ranges/Description
DC Voltage	0 to 1000V
DC Current	0 to 10A (20A for 30 seconds)
AC Voltage, True-rms	2.5 mV to 1000V – 100 kHz bandwidth
AC Current, True-rms	25 µA to 10A (20A for 30 seconds)
Resistance	0 to 500 Mohms
Conductance	0 to 500 Nanosiemens
Capacitance	0.001 nF to 50 mF
Diode Test	3.1V
Temperature	-200°C to 1350°C (-328°F to 2462°F)
Frequency	0.5 Hz to 1000 kHz
Accuracy (Basic DC V)	0.025%
(Basic AC V)	0.4%

Features

Feature	Description
Dual Displays	50,000 count primary display 5,000 count secondary display
Backlight with 2 brightness selections	Bright white backlight for clear readings in poorly lighted areas
Fast Autorange	Meter automatically selects best range – instantly
AC+DC True RMS, ac rms specified to 100 kHz	Choices for AC only, AC and DC dual display, or AC+DC readings
dBm, dBV	User selectable impedance references for dBm
AutoHOLD	Holds readings on display
Continuity/Open Test	Beeper sounds for Ohms readings below threshold or for momentary open circuit indication
Fast Bar Graph	51 Segments for peaking and nulling
Duty Cycle/Pulse Width	Measure time a signal is on or off in % or milliseconds
MIN MAX/Fast MIN MAX with elapsed and Real Time Stamp	Record Maximum, Minimum, and Average values. Real Time for MAX or MIN, elapsed time for AVG. Fast MIN MAX captures peaks to 250 µsec.
Closed Case Calibration	No internal adjustments needed
Battery/Fuse Access Door	Battery or fuse replacement without voiding calibration
Hi-Impact Overmold Case	Integrated Protective Holster provides superior impact protection for your meter

[1] For the 5,000 count mode, divide the number of least significant digits (counts) by 10.
[2] A residual reading of 8 to 180 digits with leads shorted, will not affect stated accuracy above 5% of range.
[3] 20 counts in dual display DC or AC + DC
[4] 10A continuous up to 35°C, less than 10 minutes 35° to 55°. 20A overload for 30 seconds maximum
[5] See AC conversion notes for AC mV and V.

Above specifications are subject to change without notice.

Detailed Specifications

Accuracy is specified for a period of one year after calibration, at 18°C to 28°C (64°F to 82°F) with relative humidity to 90%. Accuracy specifications are given as ±([% of reading] + [number of least significant digits])

Function	Range	Resolution	Accuracy				
			45 Hz-1 kHz	20 Hz-45 Hz	1 kHz-10 kHz	10 kHz-20 kHz	20 kHz-100 kHz
AC mV [1,2]	50,000mV	0.001mV	0.4% + 40	2% + 80	5% + 40	5.5% + 40	15% + 40
	500.00 mV	0.01 mV	0.4% + 40	2% + 80	5% + 40	5.5% + 40	8% + 40
	3000.0 mV	0.1 mV	0.4% + 40	2% + 80	0.4% + 40	1.5% + 40	8% + 40
AC V [1,2]	5.0000V	0.0001V	0.4% + 40	2% + 80	0.4% + 40	1.5% + 40	8% + 40
	50.000V	0.001V	0.4% + 40	2% + 80	0.4% + 40	1.5% + 40	8% + 40
	500.00V	0.01V	0.4% + 40	2% + 80	0.4% + 40	Not specified	Not specified
	1000.0V	0.1V	0.4% + 40	2% + 80	0.4% + 40	Not specified	Not specified
dBV	-56 to -6	0.01 dB	0.1 dB	0.2 dB	0.5 dB	0.5 dB	1.4 dB
	-6 to +34	0.01 dB	0.1 dB	0.2 dB	0.1 dB	0.2 dB	0.8 dB
	+34 to +60	0.01 dB	0.1 dB	0.2 dB	0.1 dB	Not specified	Not specified

Function	Range	Resolution	Accuracy			
			45 Hz-1 kHz	20 Hz-45 Hz	1 kHz-20 kHz	20 kHz-100 kHz
AC µA	500.00 µA	0.01 µA	0.75% + 20	1% + 20	0.75% + 20	6% + 40
	5000.0 µA	0.1 µA	0.75% + 5	1% + 5	0.75% + 10	2% + 40
AC mA	50.000 mA	0.001 mA	0.75% + 20	1% + 20	0.75% + 20	9% + 40
	400.00 mA	0.01 mA	0.75% + 5	1% + 5	1.5% + 10	4% + 40
AC A	5.0000A	0.0001A	1.5% + 20	1.5% + 20	6% + 40	Not specified
	10.000A[4]	0.001A	1.5% + 5	1.5% + 5	5% + 10	Not specified

Function	Range	Resolution	Accuracy	Accuracy Dual Display AC or AC+DC[5]		
			DC	20 Hz-45 Hz	45 Hz-1 kHz	1kHz-20 kHz
DC mV	50.000 mV	0.001mV	0.1% +20	2% + 80	0.5% + 40	6% + 40
	500.00 mV	0.01 mV	0.03% + 2	2% + 80	0.5% + 40	
	3000.0 mV	0.1 mV	0.025% + 5	2% + 80	0.5% + 40	2% + 40
DC V	5.0000V	0.0001V	0.025% + 10[3]	2% + 80	0.5% + 40	
	50.000V	0.001V	0.03% + 3[3]	2% + 80	0.5% + 40	
	500.00V	0.01V	0.1% + 2[3]	2% + 80	0.5% + 40	Not specified
	1000.0V	0.1V	0.1% + 2[3]	2% + 80	0.5% + 40	Not specified
DC µA	500.00 µA	0.01 µA	0.25% + 20	1% + 20	1% + 20	2% + 40
	5.000 µA	0.1 µA	0.25% + 2	1% + 10	0.75% + 10	2% + 40
DC mA	50.000 mA	0.001 mA	0.15% + 10	1% + 20	0.75% + 20	2% + 40
	400.00 mA	0.01 mA	0.15% + 2	1% + 10	1% + 10	3% + 40
DC A	5.0000A	0.0001A	0.5% + 10	2% + 20	2% + 20	6% + 40
	10.000A[4]	0.001A	0.5% + 2	1.5% + 10	1.5% + 10	5% + 40

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Detailed Specifications (continued)

Accuracy is specified for a period of one year after calibration, at 18°C to 28°C (64°F to 82°F) with relative humidity to 90%.
Accuracy specifications are given as ±([% of reading] + [number of least significant digits])

Function	Range	Resolution	Accuracy
Resistance[1]	500.00Ω	0.01Ω	0.05% + 10[6]
	5.0000 kΩ	0.0001 kΩ	0.05% + 2
	50.000 kΩ	0.001 kΩ	0.05% + 2
	500.00 kΩ	0.01 kΩ	0.05% + 2
	5.0000 MΩ	0.0001 MΩ	0.15% + 4[2]
	30.000 MΩ	0.001 MΩ	1% + 4[2]
	100.0 MΩ	0.1 MΩ	3% + 2[11]
	500.0 MΩ	0.1 MΩ	10% + 2[11]
Conductance	50.00 nS	0.01 nS	1% + 10
Capacitance[3]	1.000 nF	0.001 nF	2% + 5
	10.00 nF	0.01 nF	1% + 5
	100.0 nF	0.1 nF	
	1.000 µF	0.001 µF	
	10.00 µF	0.01 µF	
	100.0 µF	0.1 µF	
	1.000 µF	1 µF	
	10.0 mF	0.01 mF	
	50.00 mF	0.01 mF[5]	3% + 10
Diode Test[1]	3.1000V	0.0001V	2% + 20
Frequency	500.00 Hz	0.01 Hz[4]	± (0.005% + 1)
	5.0000 kHz	0.0001 kHz	
	50.000 kHz	0.001 kHz	
	999.99 kHz	0.01 kHz	
Duty Cycle	10.00 to 90.00%	0.1%	±(Voltage Range/ Input Voltage) x 300 counts)[9,10]
Pulse Width[5]	499.99 ms	0.01 ms	±(3% x(Voltage range/ input voltage)+ 1 count)[9,10]
	999.9 ms	0.1 ms	
Temperature	–200 to +1350°C	0.1°C	±(1% of reading + 1°C)[7,12]
	–328 to +2462°F	0.1°F	±(1% of reading + 1.8°F)[7,12]
Min-Max-Avg	Response: 100 ms to 80%		Specifed accuracy ±12 counts for changes >200 ms in duration. (±40 digits in AC for changes >350 ms and inputs >25% of range)
Fast Min-Max	250 µs[8]		Specified accuracy ±100 counts for changes >250 µs in duration[8]

[1] For the 5,000 count mode, divide the number of least significant digits (counts) by 10.
[2] For relative humidity greater than 70%, resistance accuracy is 0.5% over 1 MΩ and 2.5% over 10 MΩ.
[3] For film capacitor or better, using Relative mode (**REL** Δ) to zero residual on 1.1 nF range.
[4] Reading will be 0.00 for signals below 0.5 Hz.
[5] Least significant digit not active above 10 mF.
[6] Using relative mode (**REL** Δ) to zero residual reading.
[7] For ambient temperature changes of ± 5°C, rated accuracy applies after 1 hour.
[8] For repetitive peaks, 2.5 ms for single events.
[9] Frequency greater than 5 Hz, except for VDC, 500 mV dc and 3000 mV dc functions; 0.5 Hz to 1.0 + 0.
[10] Range/input ratios also apply to current functions.
[11] To ensure stated accuracy, switch to conductance mode and verify that the open circuit reading is less than 0.10 nS.
[12] Accuracy specification is relative to the user – adjustable temperature offset, and assumes ambient temperature stable to ± 1°C
Above specifications are subject to change without notice.

Memory and PC Communication Functions (Fluke 189 Only)

The Fluke 189 adds the following capabilities:

Interval LOGGING At least 288 intervals (specified by user in Setup) may be recorded to internal memory. These values may be viewed using the VIEW MEM function on the meter. Up to 700 unstable event values (similar to AutoHold) are automatically added to LOGGING memory for viewing only through the optional FlukeView® Forms PC software. Additional intervals will be logged if the signal is stable.

Reading SAVE Up to 100 readings may be saved by the user in a memory separate from LOGGING memory. These readings may be viewed using VIEW MEM.

Frequency Counter Sensitivity

	Approximate VAC Sensitivity (RMS Sine Wave)[1]				
Input Range	15 Hz to 100 kHz[2]	500 Hz[2]	VAC Bandwidth[3]	Approximate VCD Trigger Levels[1]	VDC Bandwidth[3]
50 mV	5 mV	10 mV	1 MHz	–5 mV & 5 mV	1 MHz
500 mV	20 mV	20 mV	1 MHz	5 mV & 65 mV	1 MHz
3000 mV	500 mV	2000 mV	800 kHz	140 mV & 200 mV	90 kHz
5V	0.5V	2.0V	950 kHz	1.4 V & 2.0 V	14 kHz
50V	5V	5.0V	1 MHz	0.5 V & 6.5 V	> 400 kHz
500V	20V	20V	1 MHz	5 V & 65 V	> 400 kHz
1000V	100V	100V	> 400 kHz	5 V & 65 V	> 400 kHz

[1] Maximum imput = 10 x Range (1000 V max). Noise at low frequencies and amplitudes may affect accuracy.
[2] Usable at reduced sensitivity to 0.5 Hz and 1000 kHz.
[3] Typical frequency bandwidth with full scale (or maximum 2 x 10^7 V-Hz product) RMS sine wave.

Burden Voltage (A, mA, µA)

Function	Range	Burden Voltage (typical)
mA- µA	500.00 µA	102 µV / µA
	5,000 µA	102 µV / µA
	50.000 mA	1.8 mV / mA
	400.00 mA	1.8 mV / mA
A	5.0000 A	0.04 V / A
	10.000 A	0.04 V / A

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Input Impedance

Function	Input Impedance (Nominal)					
Volts, mV	10 MΩ, < 100 pF					
	Common Mode Rejection Ratio			Normal Mode Rejection		
DC Volts, mV	>100 dB at dc, 50 Hz or 60 Hz ±0.1%			>90 dB at 50 Hz or 60 Hz ±0.1%		
AC Volts, mV	> 90 dB dc to 60 Hz					
	Open Circuit Test Voltage			Full-Scale Voltage		
				To 5 MΩ	30 to 500 MΩ + nS	
Ohms	< 5V			500 mV	3.1V	
Diode Test	< 5V			3.1000V		
	Typical Short-Circuit Current					
	500Ω	5 kΩ	50 kΩ	500 kΩ	5 MΩ	30 MΩ
Ohms	1 µA	100 µA	10 µA	1 µA	0.1 µA	0.1 µA
Diode Test	1.0 mA typical					

Safety Information

Function	Description
Safety	1000 V, AC/DC, maximum voltage between any terminal and earth ground. Complies with ANSI/ISA-S82.01-94, CSA C22.2 No 1010.1-92 to 1000 V Overvoltage Category III and to 600V Overvoltage Category IV. Certification agencies (approvals/listings pending): UL per standard UL 3111 (pending) CSA per standard CSA/CAN C22.2 No. 1010.1-92 TÜV per standard EN 61010 Part 1-1993 (pending)
Surge Protection	8 kV peak per IEC 1010.1-92
Fuse Protection	440 mA, 1000 V FAST Fuse, 11A, 1000V FAST Fuse
Markings	UL, CSA, TUV, CE (VDE pending)

General Specifications

Function	Description
Display	Digital: 50000/5000 counts primary, 5000 counts secondary, updates 4/second. Analog: 51 segments, updates 40/second.
Operating Temperature	-20°C to +55°C
Storage Temperature	-40°C to +60°C
Temperature Coefficient	0.05 x (specified accuracy)/°C (<18°C or >28°C)
Relative Humidity	0% to 90% (0°C to 55°C) 0% to 70% (35°C to 55°C)
Altitude	Operating: 2000 meters Storage: 10000 meters
Battery Type	4 AA Alkaline, NEDA 15A or LR6
Battery Life	72 Hours typical (with backlight off)
Shock Vibration	Per MIL-T-PRF 28800 for Class II instruments
EMC	Susceptibility and Emissions: Commercial Limits per EN61326-1
Size	10.0 cm X 20.3 cm X 5.0 cm (3.94" X 8.00" X 1.97") (Not Including Accessory Mount)
Weight	545 grams (1.2 lbs.)
Case Sealing	IP-42 per IEC 529, Section 3
Warranty	Lifetime
Calibration Interval	1 year

Above specifications are subject to change without notice.

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